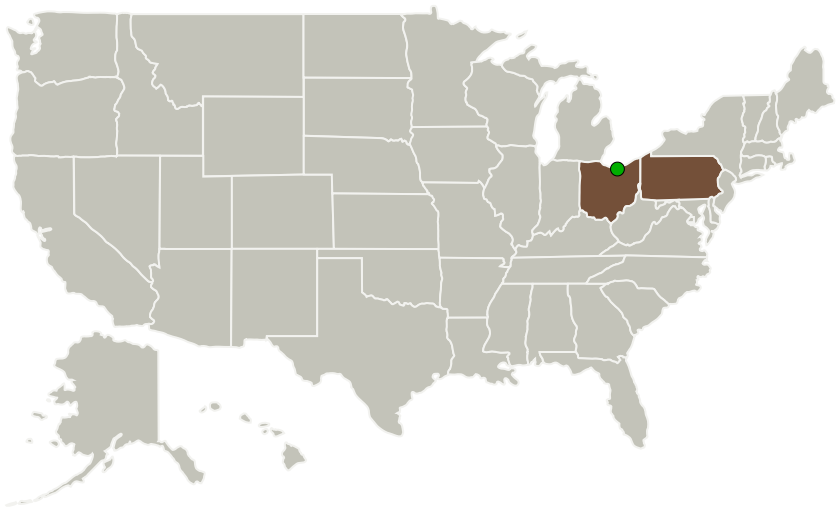
Multifunctional Electrolytes for Abuse-Tolerant 5V Li-Ion Space Batteries, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

This SBIR Phase I project will develop a multifunctional electrolyte for high energy density abuse-tolerant lithium ion batteries with 5 V cathodes such as LiCoPO4. The multifunctional electrolyte comprises of a non-flammable ionic liquid as solvent and a porous ionomer membrane which serve as both separator and lithium cation source. No additional lithium salt such as LiPF6 or LiTFSi is required. The ionic liquid and the ionomer are electrochemically stable at 5 V vs Li/Li+ for many charge-discharge cycles, therefore will enable a lithium ion battery with high voltage and high energy density. The ionomer is a high temperature polymer with anions chemically bonded to the polymer chain. With a super-CO2 facilitated processing technology, porous membrane can be formed with the ionomer with interconnected pores (~50% porosity and pore size of 0.3 ~0.6um). In addition, the porous ionomer membrane has high mechanical modulus and strength and high thermal stability >150 degree Celsius. The high energy density abuse-tolerant lithium ion battery will be enabled by combining: 1. high voltage 5 V cathode; 2. abuse-tolerant cathode that fail mildly; 3. high voltage electrolyte with cycling stability; 4. Superior ionic conductivity ~ 1 mS/cm at -20 degree C; 5. non-flammable electrolyte with ionic liquid; and 6. mechanically and thermally stable porous ionomer membrane. The energy density can be further improved by using lithium metal anode.

Primary U.S. Work Locations and Key Partners



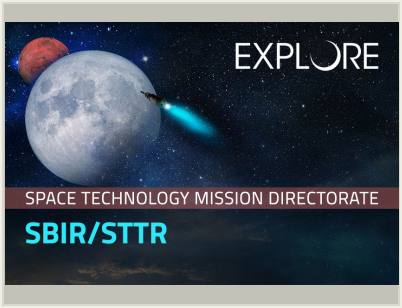


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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

Multifunctional Electrolytes for Abuse-Tolerant 5V Li-Ion Space Batteries, Phase I

Completed Technology Project (2014 - 2014)

Organizations Performing Work	Role	Type	Location
PolyK Technologies, LLC	Lead Organization	Industry	State College, Pennsylvania
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Ohio	Pennsylvania

Project Transitions

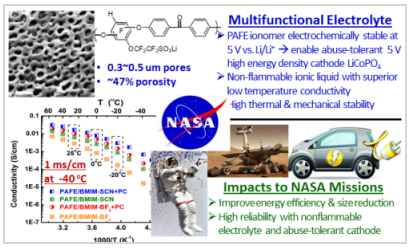
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137509)*

Images



Briefing Chart
Multifunctional Electrolytes for Abuse-Tolerant 5V Li-Ion Space Batteries, Phase I
(https://techport.nasa.gov/image/125755)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
PolyK Technologies, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

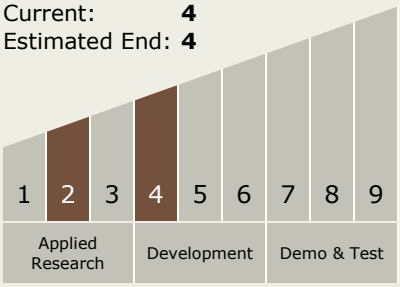
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Nanyan Zhang

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2014 - 2014)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.2 Energy Storage
    - TX03.2.1 Electrochemical: Batteries

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System